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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P4141	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/FI2004/000586	International filing date (day/month/year) 05.10.2004	Priority date (day/month/year) 08.10.2003
International Patent Classification (IPC) or national classification and IPC B01J4/00, B01J19/26, D21H23/04, B05B7/04, B01F5/04, B01F3/08		
Applicant WETEND TECHNOLOGIES OY		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

3. This report is also accompanied by ANNEXES, comprising:

- (*sent to the applicant and to the International Bureau*) a total of 9 sheets, as follows:
 - sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
 - sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
- (*sent to the International Bureau only*) a total of (indicate type and number of electronic carrier(s)), containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

- Box No. I Basis of the opinion
- Box No. II Priority
- Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- Box No. IV Lack of unity of invention
- Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- Box No. VI Certain documents cited
- Box No. VII Certain defects in the international application
- Box No. VIII Certain observations on the international application

Date of submission of the demand 06.05.2005	Date of completion of this report 02.02.2006
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer Vlassis, M Telephone No. +31 70 340-4292



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Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
 - This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
 - international search (under Rules 12.3 and 23.1(b))
 - publication of the international application (under Rule 12.4)
 - international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

Description, Pages

1, 4-7	as originally filed
2, 3, 8-10	filed with telefax on 06.05.2005

Claims, Numbers

1-23	filed with telefax on 06.05.2005
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Drawings, Sheets

1/3-3/3	as originally filed
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- a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
- 3. The amendments have resulted in the cancellation of:
 - the description, pages
 - the claims, Nos.
 - the drawings, sheets/figs
 - the sequence listing (*specify*):
 - any table(s) related to sequence listing (*specify*):
- 4. This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
 - the description, pages 2,3,8-10
 - the claims, Nos. 1-23
 - the drawings, sheets/figs
 - the sequence listing (*specify*):
 - any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superceded."

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Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	2,6,7,17
	No:	Claims	1,3-5,8-16,18-24
Inventive step (IS)	Yes:	Claims	2,6,7,17
	No:	Claims	1,3-5,8-16,18-24
Industrial applicability (IA)	Yes:	Claims	1-24
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

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Re Item I

The amendments filed by the applicant with fax dated 6/5/2005 are not considered to comply with the requirements of Art. 34(2)(b) PCT, for the following reasons:

a) The expression "solution" or "chemical solution" was replaced in the whole application by "mixture" or "mixture of chemical and mixing liquid". As basis for this amendment, the applicant referred to page 8, last line of the description as published.

On the referred page 8, last sentence it is however only clarified that the chemical solution is formed from a mixture of chemical and mixing liquid. The use of the term "solution" discloses that the one compound is solved in the other, the product being in one single liquid phase. The expressions "mixture" or "mixture of chemical and mixing liquid" is broader than the original "solution" since it embraces also dispersions etc. Therefore, this amendment introduces subject-matter which goes beyond the subject-matter of the application as originally filed.

b) The above mentioned expression was also introduced in steps d-f of amended claim 1. Furthermore, in claim 1, no basis for step e could be found in the application as originally filed. In the original set of claims, claim 4 reads "...the chemical solution is fed to the liquid flow mentioned by means of a feed liquid coming from outside the chemical solution flow mentioned". On page 8, last line - page 9 first line it says "...the chemical solution...is at first fed via openings 152 to the feed liquid flow...". Similar phrasing is found in original claims 13 and 24.

Therefore, step e, introduces subject-matter which goes beyond the subject-matter of the application as originally filed, because "discharging" is broader than either "feeding by means of a liquid coming from outside" or "feeding via openings".

c) The expression "mixture of chemical and mixing liquid" in present claim 8 is contravening Art.34(2)(b) PCT for the reasons given under paragraph a. Furthermore, in the last part of claim 8 says "means 152 for feeding...". Through out the whole description and original claims such means 152 are defined as "opening". The present expression in claim 8 is therefore broader than the original disclosure.

(Present claim 8 is furthermore not complying with Art.6 PCT for the following reasons:
-the last part of the claim is in contradiction with claim 22).

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For the reasons mentioned above, the amendments introduced with fax dated 6/5/2005 do not comply with the requirements of Art.34(2)(b) PCT and therefore, the previous set of claims forms the basis for the subsequent examination.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1) Notwithstanding the lack of clarity mentioned under the Item VIII, the subject-matter of claims 1,3-5, 8-16,18,20-24 is not new in the sense of Article 33(2) PCT, and therefore the criteria of Article 33(1) PCT are not met.

The term "isolated space" is considered to be a vague and unclear term (see also item VIII). For the scope of assessment of novelty and inventive step of the claims this term was understood as meaning a "space isolated from the feed liquid and the flowing process liquid" (see description, page 8, line 31-page 9, line 2).

D1 discloses a feeding device suitable for feeding chemical into a liquid flow. The feeding device includes a nozzle casing (see reference number 7 on fig.1) and apparatus disposed in connection therewith, means (see reference number 22 in fig.1) in the form of a thin pipe-like duct, suitable for feeding chemical and means (see reference number 38 in fig.1) suitable for feeding mixing liquid to an isolated space (see reference number 42) disposed in connection with the nozzle casing, at the end of the mixing liquid feed device. The pipe-like duct extends centrally inside the feed duct (see fig.1). Additionally there are openings (see reference number 11 in fig.1) provided in the wall of the mixing liquid feed device in connection with the isolated space and feed openings into which the mixing liquid feed means extend. The mixing liquid feed duct is extending at least partly inside the nozzle casing. The pipe-like duct is secured with means (see reference number 13 in fig.1) to the mixing liquid feed duct. There are means (see reference sign 10 in fig.1) for securing the mixing liquid feed duct to the nozzle casing. The reactor 1 in D1 is equivalent to liquid flow duct in the application.

Therefore, the subject-matter of claims 8-16,18,23,24 is not novel in view of D1.

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In a similar way, D2 appears to anticipate novelty of both independent claims 1 and 8 (see fig.1) by regarding pipe with reference sign 34 as the thin pipe-like duct, pipe with reference sign 3 as the means for feeding the mixing liquid, the space within nozzle 10 as the isolated space and 11 as the liquid flow duct (with reference sign 70 in the application), receiving liquid from duct with reference sign 33. All pipes have valves for regulating the flow. Additionally, the mixing liquid is water and the chemical steam.

Therefore, the subject-matter of claims 1,3-5,8-11,14,15,20-22 is not novel in view of D2.

Item VIII

1) It is clear from the description on page 2, lines 21-29 that the feature "thin-pipe-like duct" for feeding the chemical is essential to the definition of the invention.

Since independent claims 1 and 8 do not contain this feature they do not meet the requirement following from Article 6 PCT taken in combination with Rule 6.3(b) PCT that any independent claim must contain all the technical features essential to the definition of the invention.

2) The term "isolated space" as presently mentioned in the claims, is vague and unclear and leave the reader in doubt as to the meaning of the technical features to which it refers, thereby rendering the definition of the subject-matter of said claims unclear, Article 6 PCT.

3) Claim 19 does not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. The claim attempts to define the subject-matter in terms of the result to be achieved, which merely amounts to a statement of the underlying problem, without providing the technical features necessary for achieving this result.

- and/or dilution liquid tend to accumulate in the device. In other words solid material tends accumulate in the device parts converging in the flow direction, which gradually harm the flow profile, the flow itself and in the end tend to clog the device. FI patent application no. 20021350 describes a self-cleaning chemical feed nozzle. In other
5 words when the nozzle starts to become clogged a change take place in its flow conditions which causes a reaction of the nozzle to open wider the cross-sectional flow area of the flow channel in which the solid material in question flows with the fiber suspension; as a result of this the solid particles attached to the channel can get loose from the nozzle and flow on.
- 10 In this kind of applications, i.e. feeding for example retention chemicals into a fiber suspension, the mixing devices and the nozzles described in the publications mentioned work well but in cases where only very small amounts of chemicals are needed in relation to the suspension flow to be fed, the operation of the these nozzles
15 is not the best possible for example because they cannot guarantee an adequately homogenous mixing of the chemical into the process liquid flow because of the small volume of the chemical.
- 20 In order to solve, among other things, the problem described above, a new type of a chemical feeding device has been developed the structure of which is very favorable in feeding small chemical amounts into a liquid flow. The feeding device according to the invention includes a thin pipe-like duct disposed preferably inside the feeding device/nozzle so that the desired amount, in this case as small an amount as possible, of chemical can be mixed evenly into the process liquid flow. The pipe-like duct
25 feeding the chemical supplies the chemical into a special nozzle of the feeding device which is preferably designed to have a kind of an isolated mixing space where the chemical and mixing liquid supplied to the feeding device through an inlet of its own are mixed and from which they only after this mixing are fed through openings in the mixing space at first into the feeding liquid and after that aided by the feeding liquid
30 mentioned to the flowing process liquid. The mixing and the dilution of the chemical to a mixture of chemical and mixing liquid before it is fed to the process liquid flow pipe ensure uniform mixing of the chemical into the process liquid. As a result of this, the volume of the chemical to be fed into the feeding device can be of the order of even less than half a percent of the rest of the liquids supplied into the feeding device, which
35 are the mixing liquid and the feeding liquid supplying the mixing liquid and the chemical into the liquid flow. If desired, several

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feeding devices according to the invention instead of one may be disposed in connection with the process liquid flow duct.

The structure of the feeding device according to the invention, more precisely
5 expressed the isolated mixing space provided at the end of the mixing liquid feed pipe, improves the mixing of the chemical also in another way. When hitting the wall of the isolated mixing space the liquid chemical is "dispersed" evenly to the whole interior of the isolated mixing space of the nozzle and is mixed and diluted more homogenously into the mixing liquid. In addition to this structure the feeding device can further
10 include a kind of an additional counter piece which, when disposed in the middle of the mouth of the pipe-like duct feeding the chemical, further improves the mixing to the other liquids to be fed and further to the liquid flow to be fed.

The chemical can be fed into the feeding device according to the invention without
15 separate dilution, in other words the dilution takes place with the mixing liquid in the isolated mixing space of the feeding device. This mixture of chemical and mixing liquid dispenses among other things with the need to use separate dilution vessels, reduces the consumption of fresh water and thus reduces the operation and maintenance costs. On the other hand, it is possible also to dilute the chemical before it is supplied
20 to the feeding device if so desired.

The feeding device according to the invention may be used for example in the feeding of chemicals, such as for example TiO₂, optical brighteners, paper dyes and silicates, into the flowing process liquid, only to mention a few chemicals. Thus the feeding
25 device according to the invention is applicable in all processes into which the chemicals mentioned must be supplied, in particular when the amount of the chemical is very little compared with the total flow of suspension flowing to the process. As advantageous examples, only, of the processes may be mentioned for example fiber suspension flows of paper mills, thickening processes of various sludges, recycling
30 fiber processes, bleaching processes and in general processes where feeding of chemical in particular in very small amounts into filtrate, fiber suspension, sludge or the like is necessary.

The mixing device according to the invention allows using as the feeding liquid with
35 which the chemical is supplied into the process liquid, for example into fiber suspension, the same fiber suspension into which the chemical is to be fed. Of course also more

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88 as seen from the flow duct 70, has been provided with an opening 56 for the mixing liquid to be fed to the feed device 34. The feed opening 56 communicates via a mixing liquid conduit 146, which in this embodiment is preferably tangential in relation to the feed device 34, and an adjustable valve 44 with the mixing liquid feed pipe for supplying mixing liquid into the feed device 34.

The chemical feed duct 162, which is preferably a very thin pipe for feeding small chemical volumes, extends in this embodiment of the invention to the feed device 34 from above. The feed duct 162 is also in this embodiment bent at a location above the feed device 34 to the same direction as the connections 144 and 146 for feed and mixing liquids. The volume of the chemical to be fed may be adjusted for example with a valve 46 located in the chemical feed duct 162. The chemical feed duct 162 has been secured to an elongate outer end 22 of the feed device 34 with a securing means 20. The feed duct 162 communicates with the mixing liquid feed duct 142 by being located in this embodiment centrally inside the mixing liquid feed duct 142 and extending close to the special nozzle part 150 of the feed duct 142 which nozzle part in turn is adjustable to extend inside the process liquid flow duct 70.

In this embodiment of the invention the chemical feed duct 142 has at the lower end of it, in other words at the end facing the fiber suspension flow duct 70 and extending inside the nozzle casing 80, a conical converging portion 148 which is essentially located at the conical portion 82 of the nozzle casing 80 and its coning angle is of the same order as that of the conical converging portion 82 of the nozzle casing 80. The conical converging portion 148 of the mixing liquid feed duct 142 does not extend quite to the lower end of converging portion 82 for the feed liquid but the feed duct continues preferably as a cylindrical duct 116 inside the feed opening 84 whereby the cross-sectional flow area between these parts reduces in the flow direction caused an increasing in the flow velocity of the feed liquid. The flow velocity of the mixture of the chemical to be fed into the process liquid flowing in the process liquid flow duct 70 and the feed liquid is at the feed moment at least five time the speed of the process liquid flow.

The cylindrical duct 116 at the lower end of the mixing chemical feed duct 142 ends at the nozzle part 150 which provides the mixing space 154 isolated from the feed liquid and the flowing process liquid required for the chemical mixing and from which the mixture of chemical and mixing liquid is at first fed via openings

- 152 to the feed liquid flow and further by means of the feed liquid in an even flow to the liquid flow duct 70. The isolated mixing space 154 in the nozzle part 150 is formed for example of a cup-like "closed" end 156 of the mixing liquid flow duct 142 and of the openings 152 provided at its sides. The openings 152 have been provided in the wall 5 of the flow duct 142 above the mixing space 154 of the nozzle part 150. Via the openings 152 the mixing liquid and the chemicals mixed into it are discharged practically in a radial fan-like flow to the feed liquid. The openings 152 may have a round, angular or for example slot-like configuration only to mention a few examples. The thin pipe-like chemical feed duct 162 extends to the end 156 of the nozzle part 10 150, preferably past the openings 152. This embodiment guarantees a good chemical mixing result as the chemical jet hits the end of the nozzle part 150 and is from there disperses evenly to the entire mixing liquid volume and further via openings 152 to the liquid flow duct 70. The mixing and the dilution of the chemical thus take place before the feeding to the process liquid by means of the feed liquid. This ensures that precise 15 chemical amounts are mixed into the whole cross-sectional flow area of the process liquid. According to another preferred embodiment of the invention a kind of an additional, for example conical, counter piece has been provided, if necessary, in the end of the chemical feed duct 162 quite in the center of it whereby, when hitting it, the chemical jet is dispersed and mixed even more efficiently. Another alternative is to 20 design the end cup 156 of the duct 142 so that it divides the chemical flow coming from the duct 162 evenly to different sides of the duct 162 for example by providing the bottom of the end cup at a central position relative to the duct 162 with a conical or corresponding bulge converging towards the duct.
- 25 Preferably the nozzle part 150 of the mixing liquid flow duct 142 and the mixing space therein are located inside the process liquid flow duct 70 or at least in the close vicinity of the inner surface of the flow duct 70 mentioned so that the mixing of the chemical to the mixing liquid takes place 0.5 seconds, at the most, before the mixture of chemical and mixing liquid is mixed with the process liquid. Compared with the situation 30 illustrated in Figure 3, where the openings 152 are located just inside the wall of the process liquid flow duct 70 (illustrated schematically), the openings 152 may be located at the annular feed opening 84 for feed liquid, thus inside the duct portion 76.

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The function of the feed liquid discharging from the opening 84 of the feed device 34 is to give the mixture of chemical and mixing liquid the required velocity which feeds the mixture of chemical and mixing liquid efficiently across the whole cross-sectional flow area of the liquid flow duct 70. The feed liquid hits mainly axially the mixture jet 5 discharging from the openings 152 in an almost radial direction, increasing the velocity of the chemical and improving the mixing with the process liquid flowing in the flow duct 70. The direction and penetration of the chemical jet are adjusted by adjusting the feed device 34 with the screw 138 and the feed pressure with valves 42, 44 and 46.

10

As may be seen from the above, a feeding device of a new type for feeding and mixing various chemicals in small, precisely predetermined amounts to process liquid flows has been developed. It should also be noted that although the above description generally discusses the use of the feed nozzle according to the invention particularly in 15 connection with applications in wood processing industry the invention may be applied anywhere where chemicals need to be fed and mixed into a medium flow evenly and in precise amounts. Thus, the field of application and the scope of protection of the invention are defined by the appended patent claims, only.

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We claim:

1. A method of feeding chemical into a process liquid flow by means of a feed device having a nozzle casing, according to which method chemical is fed to the process liquid flow by means of a feed liquid, characterized by the steps of
 - a) locating a mixing space (154) in connection with the nozzle casing (80) of the feed device (34),
 - b) isolating the mixing space (154) from the feed liquid and the flowing process liquid,
 - c) introducing said chemical via a thin pipe-like duct (162) into said mixing space (154),
 - d) mixing said chemical in the mixing space (154) with a mixing liquid, the mixing liquid being fresh water or a circulation liquid obtained from the process, to form a mixture of chemical and mixing liquid,
 - e) discharging the mixture of chemical and mixing liquid from the mixing space (154) to the feed liquid flow,
 - f) feeding the mixture of chemical and mixing liquid by means of the feed liquid to the process liquid flow.
- 20 2. A method according to claim 1, characterized in that the chemical is mixed with the mixing liquid less than 0.5 seconds before the mixture of the chemical and the mixing liquid is mixed with said liquid flow.
- 25 3. A method according to claim 1, characterized in that the chemical and the mixing liquid are brought to the isolated mixing space (154) in at least two flow paths separated from each other and disposed one inside the other.
- 30 4. A method according to any of the preceding claims, characterized in that the mixture of chemical and mixing liquid is fed to said process liquid flow by means of a feed liquid coming from outside said mixture of chemical and mixing liquid flow.
- 35 5. A method according to claim 4, characterized in that process liquid to be fed to the process is used as the feed liquid.

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6. A method according to any of the preceding claims, characterized in that the mixing of the chemical and mixing liquid is adjusted by changing the location of the isolated mixing space in relation to said liquid flow duct.
- 5 7. A method according to any of the preceding claims, characterized in that the chemicals to be mixed are TiO₂, optical brighteners, paper dyes or silicates.
8. A feeding device for feeding chemical into a process liquid flow, the feeding device (34) including at least a nozzle casing (80), and apparatus (84, 88, 144) disposed in connection therewith for supplying feed liquid for introducing said chemical to said process liquid flow, characterized by
- 10 - a mixing space (154) isolated from the feed liquid and the flowing process liquid,
 - said mixing space (154) being disposed in connection with the nozzle casing (80),
- 15 - a thin pipe-like duct (162) for feeding chemical to said mixing space and means (142) for feeding mixing liquid to said mixing space (154) for producing a mixture of chemical and mixing liquid, and
 - means (152) for feeding the mixture of chemical and mixing liquid to the feed liquid, said mixture being fed to said process liquid flow duct (70) by means of the feed liquid.
- 20
9. A feeding device according to claim 8, characterized in that said mixing liquid feed device is a mixing liquid feed duct (142) for feeding mixing liquid to the mixing space (154).
- 25
10. A feeding device according to claim 8 and 9, characterized in that said chemical feeding duct (162) extends to the isolated mixing space (154) centrally inside the feed duct (142).
- 30
11. A feeding device according to any of the claims 8 - 10, characterized in that said isolated mixing space (154) has been provided at the end of the mixing liquid feed device (142) facing the liquid flow duct (70).
12. A feeding device according to any of the claims 8 - 11, characterized in
- 35 that there are openings (152) provided in the wall of the mixing liquid feed device (142)

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in connection with the isolated mixing space (154) for feeding the mixture of chemical and mixing liquid to the feed liquid flow.

13. A feeding device according to any of the claims 8 - 12, characterized in that
5 said means for feeding mixing liquid to said liquid flow duct (70) include at least a feed opening (84) into which also the mixing liquid feed means (142) extend.

14. A feeding device according to the claim 9, characterized in that said mixing liquid feed duct (142) is at least partly located inside the nozzle casing (80) feeding the
10 feed liquid.

15. A feeding device according to any of the claims 8 - 14, characterized in that the chemical feed duct (162) has been secured with means (20, 22) to the mixing liquid feed duct (142).

15 16. A feeding device according to the claim 9, characterized in that there are means (136, 138) in the mixing liquid feed duct (142) for securing the feed duct (142) to the nozzle casing (80) so that its position can be adjusted.

20 17. A feeding device according to any of the claims 8 - 16, characterized in that there are means (74, 76) in the feed device (34) for securing the nozzle casing (80) to the process liquid flow duct (70).

25 18. A feeding device according to any of the claims 8 - 17, characterized in that the feeding device (34) is adjustable by means of apparatus (94, 136, 138).

19. A feeding device according to any of the claims 8 - 18, characterized in that there is a conical converging portion (82) in the nozzle casing (80), by means of which the cross-sectional area of the flow path of the feed liquid to be supplied to the feeding
30 device (34) via the connection (144) and the opening (88) is reduced in order to increase the flow velocity.

20. A feeding device according to claim 9, characterized in that there is a conical converging portion (148) in the mixing liquid feed duct (142), by means of which cross-
35 sectional area of the flow path of the mixing liquid to be supplied to the feeding device

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(34) via the connection (146) and the opening (56) is reduced in order to increase the flow velocity.

21. A feeding device according to any of the claims 8 - 20, characterized in that
5 there are valves (42, 44, 46) in the chemical flow duct (162) and connections (144, 146)
to control the liquid flow.

22. A feeding device according to any of the claims 8 - 21, characterized in that
the feed openings (152) for the mixture of chemical and mixing liquid are located inside
10 said liquid flow duct (70) when the feed device has been secured to the flow duct (70).

23. A feeding device according to any of the claims 8 - 22, characterized in that
the feed openings (152) for the mixture of chemical and mixing liquid are located in the
feed liquid feed opening (84).

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